

WHAT IS CLAIMED IS:

1. A bone fastener assembly, comprising:
a collar;
5 a ring coupled to the collar, wherein the ring comprises two or more seats;
a bone fastener comprising a shank, a head, and two or more splines on the head of the bone fastener, wherein at least one of the splines is configured to couple to at least one of the seats to inhibit separation of the bone fastener from the collar; and
wherein the ring is configured to allow polyaxial movement of the collar relative to the
10 shank.
2. The bone fastener assembly of claim 1, wherein the two or more splines are distributed circumferentially about the head of the bone fastener.
- 15 3. The bone fastener assembly of claim 1, wherein the head of the bone fastener comprises three splines.
4. The bone fastener assembly of claim 1, wherein the collar is configured so that the ring can be inserted into the collar between two arms of the collar, and wherein removal of the ring
20 from the collar is inhibited after the ring is coupled to the collar.
5. The bone fastener assembly of claim 1, wherein the collar is configured so that the ring can be inserted into the collar through a bottom of the collar, and wherein removal of the ring from the collar is inhibited after the ring is coupled to the collar.
- 25 6. The bone fastener assembly of claim 1, wherein the ring is configured to compress during insertion of the ring in a body of the collar, and wherein the compressed ring is configured to expand in the body of the collar after insertion to inhibit removal of the ring from the collar.
- 30 7. The bone fastener assembly of claim 1, wherein at least one of the splines is configured to couple with an inner surface of the ring to inhibit removal of the head from the ring.

8. A bone fastener assembly, comprising:

a collar;

a ring coupled to the collar, wherein the ring comprises two or more grooves and two or

5 more seats;

a bone fastener comprising a shank, a head, and two or more splines on the head of the bone fastener, wherein the splines are configured to pass at least partially through the grooves in the ring, and wherein at least one of the splines is configured to couple to at least one of the seats to inhibit separation of the bone fastener from the collar; and

10 wherein the ring is configured to allow polyaxial movement of the collar relative to the shank.

9. The bone fastener assembly of claim 8, wherein the two or more splines are distributed circumferentially about the head of the bone fastener.

15 10. The bone fastener assembly of claim 8, wherein the head of the bone fastener is configured to pass through a bottom of the collar, wherein the two or more splines are configured to pass through the two or more grooves, and wherein the bone fastener is configured to be rotated and positioned in the two or more seats of the ring.

20 11. The bone fastener assembly of claim 8, wherein the head of the bone fastener comprises three splines.

25 12. The bone fastener assembly of claim 8, wherein at least one of the splines is configured to couple with an inner surface of the ring to inhibit removal of the head from the ring.

13. A bone fastener, comprising:

a head and a shank;

two or more splines on the head of the bone fastener, wherein at least one of the splines is

30 configured to couple the bone fastener to a ring in a collar; and

wherein the bone fastener is configured to be inserted head first through an opening in the ring, rotated relative to the ring, and seated in the ring.

14. The bone fastener of claim 13, wherein the two or more splines are distributed circumferentially about the head of the bone fastener.
- 5 15. The bone fastener of claim 13, wherein the bone fastener is cannulated.
16. The bone fastener of claim 13, wherein the head of the bone fastener comprises three splines.
- 10 17. The bone fastener of claim 13, wherein at least one of the splines is configured to couple with an inner surface of the ring to inhibit removal of the head from the ring.
18. The bone fastener of claim 13, wherein at least one of the splines comprises a projection configured to couple with the ring to inhibit removal of the head from the ring.
- 15 19. The bone fastener of claim 13, wherein at least one of the splines is tapered.
20. The bone fastener of claim 13, wherein an inner surface of the ring comprises two or more grooves, and wherein the grooves are configured to allow passage of the two or more splines.
- 20 21. A collar, comprising:
a body;
arms extending from the body, each arm comprising internal threading, wherein each arm
25 has an end distal from the body, and wherein the end of each arm comprises an outer flange configured to couple to a detachable member; and
a slot between the arms, wherein the slot is configured to receive an elongated member.
22. The collar of claim 21, wherein the detachable member comprises a sleeve.
- 30 23. The collar of claim 21, wherein the body of the collar is configured to couple to a bone fastener such that the bone fastener can angulate with respect to the collar.

24. The collar of claim 21, wherein the body of the collar is configured to couple to a ring.
25. The collar of claim 21, wherein the detachable member is configured to couple to the
5 flanges above the elongated member.
26. The collar of claim 21, wherein an effective diameter of the body exceeds an effective diameter of the arms.
- 10 27. The collar of claim 21, wherein at least one of the flanges comprises an indentation, and wherein the indentation is configured to allow radial orientation of a detachable member relative to the collar.
28. The collar of claim 21, wherein at least one of the flanges comprises an indentation, and
15 wherein the indentation is configured to allow the detachable member to be secured in position relative to the collar.
29. The collar of claim 21, wherein at least one of the flanges comprises an indentation, and wherein the indentation allows a channel in the detachable member to be aligned with the slot in
20 the collar.
30. The collar of claim 21, wherein the internal threading in the arms is configured to engage external threading of a closure member, and wherein the closure member is configured to secure the elongated member to the collar.
- 25 31. The collar of claim 21, wherein the collar comprises one or more threaded openings proximate at least one of the flanges, wherein one or more of the threaded openings is configured to engage movable members coupled to the detachable member.
- 30 32. The collar of claim 21, wherein the internal threading comprises a female modified thread, and wherein the female modified thread comprises a female proximal surface and a

female distal surface, and further comprising a closure member comprising a male modified thread, wherein the male modified thread comprises a male proximal surface and a male distal surface, and wherein the male proximal surface of the closure member is configured to couple with the female distal surface of the collar, and wherein the female proximal surface and the male distal surface each comprise at least one raised portion, and wherein one or more surfaces of such raised portions are configured to couple during use to inhibit radial expansion of the collar.

33. The collar of claim 21, wherein the internal threading comprises a female modified thread, wherein the female modified thread comprises a female distal surface, and further comprising a closure member comprising a male modified thread, wherein the male modified thread comprises a male proximal surface, wherein the male proximal surface is configured to slope at a forward angle, wherein the male proximal surface is configured to couple with the female distal surface during use, and wherein the male proximal surface and the female distal surface each comprises a raised portion, wherein the raised portions are configured to contact each other during use to inhibit separation of the arms.

34. The collar of claim 21, wherein the flanges are located such that the detachable member can couple to the collar above the elongated member.

35. A system, comprising:
a collar, comprising:

a body configured to couple to a bone fastener such that the body, once coupled, can at least partially rotate relative to the bone fastener;

arms extending from the body, each arm comprising internal threading; and

a slot between the arms, wherein the slot is configured to receive an elongated member;

a sleeve; and

wherein the collar is configured to couple to the sleeve above the elongated member.

36. The system of claim 35, wherein the body of the collar, once coupled to the bone fastener, can at least partially angulate relative to the bone fastener.

5 37. The system of claim 35, wherein the internal threading of the collar is configured to couple to a closure member.

38. The system of claim 35, wherein each arm of the collar comprises a flange, wherein the flanges are configured to couple to the sleeve such that the sleeve can be coupled in a selected orientation relative to the flange.

10 39. The system of claim 35, wherein each arm of the collar comprises a flange, wherein the sleeve comprises one or more channels, and wherein the flanges are configured to couple to the sleeve such that the sleeve can be coupled such that at least one of the channels is substantially aligned with the slot of the collar.

15 40. A collar, comprising:
a body configured to couple to a bone fastener such that the body, once coupled, can at least partially rotate relative to the bone fastener;
arms extending from the body;
20 a slot between the arms, wherein the slot is configured to receive an elongated member; wherein the collar is configured to couple to a sleeve above the elongated member; and wherein the arms of the collar have a smaller effective diameter than a bottom of the collar.

25 41. The collar of claim 40, wherein each arm comprises a flange, and wherein the flanges are configured to couple to the sleeve.

42. The collar of claim 40, wherein each arm comprises internal threading configured to couple to a closure member.

30 43. The collar of claim 40, wherein the body is configured to couple to a ring such that the ring, once coupled, can rotate relative to the collar.

44. The collar of claim 40, wherein the collar is configured to rotate and angulate with respect to the bone fastener.

45. A closure member, comprising:

5 a male modified thread configured to couple with a female modified thread in an opening in a collar;

wherein the female modified thread comprises a female proximal surface and a female distal surface;

10 wherein the male modified thread comprises a male proximal surface and a male distal surface, and wherein the male proximal surface of the closure member is configured to couple with the female distal surface of the collar; and

wherein the female proximal surface and the male distal surface each comprise at least one raised portion, and wherein one or more surfaces of such raised portions are configured to couple during use to inhibit radial expansion of the collar during use.

15 46. The closure member of claim 45, wherein the male proximal surface is a load-bearing surface.

20 47. The closure member of claim 45, wherein the female distal surface is a load bearing surface.

25 48. The closure member of claim 45, wherein the collar comprises a body and arms, wherein the female modified thread is formed on an inside surface of each arm, and wherein the male modified thread and the female modified thread are configured to inhibit separation of the arms during use.

30 49. The closure member of claim 45, wherein the collar comprises a body and arms, wherein the female modified thread is formed on an inside surface of each arm, and wherein the closure member is configurable to bear against an elongated member positioned in a slot between the arms during use to inhibit movement of the elongated member relative to the collar.

50. The closure member of claim 45, wherein the female modified thread and the male modified thread are configured for a running fit.

51. The closure member of claim 45, wherein the female modified thread and the male modified thread are configured for an interference fit.

52. The closure member of claim 45, wherein the collar comprises a body and arms, wherein the female modified thread is formed on an inside surface of each arm, and wherein each raised portion comprises a contact surface that is substantially parallel to a central longitudinal axis extending between the arms of the collar.

53. The closure member of claim 45, wherein the female distal surface comprises a positive slope and wherein the male proximal surface comprises a positive slope.

54. The closure member of claim 45, wherein the female distal surface comprises a negative slope and wherein the male proximal surface comprises a negative slope.

55. The closure member of claim 45, wherein the collar comprises a body and arms, wherein the female modified thread is formed on an inside surface of each arm, and wherein the female distal surface and the male proximal surface are generally perpendicular to a central longitudinal axis extending between the arms of the collar.

56. A closure member, comprising:

a male modified thread configured to couple to a female modified thread on an inside surface of a collar comprising arms and a body;

wherein the arms define a bore comprising the female modified thread, and wherein the female modified thread comprises a female distal surface;

wherein the male modified thread comprises a male proximal surface, wherein the male proximal surface is configured to slope at a forward angle, and wherein the male proximal surface is configured to couple with the female distal surface during use; and

wherein the male proximal surface comprises a raised portion and wherein the female distal surface comprises a raised portion, and wherein the raised portions are configured to contact each other during use to inhibit separation of the arms.

5 57. The closure member of claim 56, wherein the male modified thread and the female modified thread are configured to inhibit radial expansion of the collar during use.

10 58. The closure member of claim 56, wherein the closure member is configurable to bear against an elongated member positioned in a slot between the arms during use to inhibit movement of the elongated member relative to the collar.

59. The closure member of claim 56, wherein the female modified thread and the male modified thread are configured for a running fit.

15 60. The closure member of claim 56, wherein the female modified thread and the male modified thread are configured for an interference fit.

20 61. The closure member of claim 56, wherein each raised portion comprises a contact surface that is substantially parallel to a central longitudinal axis extending between the arms of the collar.

62. The closure member of claim 56, wherein the female distal surface comprises a positive slope and wherein the male proximal surface comprises a positive slope.

25 63. The closure member of claim 56, wherein the female distal surface comprises a negative slope and wherein the male proximal surface comprises a negative slope.

30 64. The closure member of claim 56, wherein the female distal surface and the male proximal surface are generally perpendicular to a central longitudinal axis extending between the arms of the collar.

65. A method for inserting a spinal stabilization system in a human spine, comprising:
making an incision in skin near human vertebrae to be stabilized;
pulling the incision toward a first one of the human vertebrae to be stabilized;
inserting a first bone fastener assembly in the incision and securing the first bone fastener
5 assembly to the first human vertebra;
pulling the incision toward a second one of the human vertebrae to be stabilized; and
inserting a second bone fastener assembly in the incision and securing the second bone
fastener assembly to the second human vertebra.
- 10 66. The method of claim 65, wherein the incision is made in skin above and substantially
between the human vertebrae to be stabilized.
67. The method of claim 65, wherein insertion angles of the bone fastener assemblies are
determined by patient anatomy.
- 15 68. The method of claim 65, further comprising creating a tissue plane between the first bone
fastener assembly and the second human vertebra to be stabilized.
69. The method of claim 68, wherein the tissue plane is substantially trapezoidal.
- 20 70. The method of claim 68, further comprising releasing the incision before creating the
tissue plane.
71. The method of claim 65, further comprising using an estimating tool to estimate a length
25 of an elongated member needed to couple the bone fastener assemblies.
72. The method of claim 65, wherein the first bone fastener assembly is coupled to a first
sleeve, and wherein the second bone fastener assembly is coupled to a second sleeve.
- 30 73. The method of claim 72, wherein an angle of at least one of the sleeves relative to a
surface of the skin may be adjusted to maintain a size of the incision.

74. The method of claim 72, further comprising guiding an elongated member down channels in the sleeves, through the incision, and through a tissue plane toward the bone fastener assemblies.

5 75. The method of claim 74, further comprising bending the elongated member before inserting the elongated member in the sleeves, wherein the elongated member is bent to inhibit increasing a length of the incision.

10 76. The method of claim 72, wherein relative movement of the sleeves is substantially unconstrained prior to insertion of an elongated member.

77. The method of claim 72, wherein the sleeves cross substantially at or near the incision following insertion of the bone fastener assemblies.

15 78. The method of claim 72, further comprising initially inserting an elongated member substantially longitudinally down one of the sleeves.

79. The method of claim 72, wherein an adjustable positioner is used to guide an elongated member down the sleeves, through a tissue plane, and into the bone fastener assemblies.

20 80. The method of claim 79, further comprising rotating the elongated member subcutaneously to position the elongated member in the bone fastener assemblies.

25 81. The method of claim 80, wherein the elongated member is rotated subcutaneously without visualization.

82. The method of claim 72, further comprising securing an elongated member to the bone fastener assemblies.

30 83. The method of claim 72, further comprising securing an elongated member to each bone fastener assembly with a closure member and counter torquing at least one of the sleeves above the incision while a tool portion of a closure member is sheared off.

84. The method of claim 72, further comprising removing the sleeves from the bone fastener assemblies from above the incision.

85. The method of claim 65, further comprising inserting an elongated member in the bone fastener assemblies and securing the elongated member to the bone fastener assemblies with closure members.

86. A method for inserting a spinal stabilization system in a human spine, comprising:
making an incision in skin near human vertebrae to be stabilized;

inserting a first bone fastener assembly in the incision and securing the first bone fastener assembly to a first one of the human vertebrae to be stabilized;

creating a substantially trapezoidal tissue plane near the human vertebrae to be stabilized, wherein the substantially trapezoidal plane has a dimension near the human vertebrae that is larger than the opposite dimension near the incision; and

inserting a second bone fastener assembly in the incision and securing the second bone fastener assembly to a second one of the human vertebrae to be stabilized.

87. The method claim 86, wherein the incision is made above and substantially between the human vertebrae to be stabilized.

88. The method claim 86, further comprising moving the incision to create the substantially trapezoidal tissue plane.

89. The method claim 86, wherein the human vertebrae to be stabilized comprise two human vertebrae, and wherein the substantially trapezoidal plane is near the two human vertebrae.

90. The method claim 86, wherein the human vertebrae to be stabilized comprise three human vertebrae, and wherein the substantially trapezoidal plane is near the three human vertebrae.

91. The method claim 86, further comprising inserting a third bone fastener assembly into a third one of the human vertebrae to be stabilized.

92. The method claim 86, wherein the first bone fastener assembly is coupled to a first sleeve, and wherein the second bone fastener assembly is coupled to a second sleeve.

93. A method for inserting a spinal stabilization system in a human spine, comprising:

5 making an incision near human vertebrae to be stabilized;

inserting a first bone fastener assembly in the incision and securing the first bone fastener assembly to a first one of the human vertebrae;

creating a tissue plane between the first bone fastener assembly and another one of the human vertebrae to be stabilized;

10 inserting one or more other bone fastener assemblies in the incision and securing each of the other bone fastener assemblies to another one of the human vertebrae to be stabilized; and

bending an elongated member to allow coupling of the bone fastener assemblies with the elongated member without substantially enlarging a length of the incision.

15 94. The method of claim 93, wherein a shape of the tissue plane is substantially trapezoidal.

95. The method of claim 93, wherein each bone fastener assembly is coupled to a sleeve.

20 96. The method of claim 95, further comprising inserting at least one end of the elongated member in at least one channel in at least one of the sleeves, guiding the elongated member through the incision, and advancing the elongated member through the tissue plane toward the bone fastener assemblies.

25 97. The method of claim 95, further comprising securing the elongated member to the bone fastener assemblies.

98. The method of claim 95, further comprising securing an elongated member to each bone fastener assembly with a closure member and counter torquing at least one of the sleeves above the incision while a tool portion of a closure member is sheared off.

30 99. The method of claim 95, further comprising removing the sleeves from the bone fastener assemblies from above the incision.

100. A method of inserting a spinal stabilization system in a human spine, comprising:
making an incision in skin near human vertebrae to be stabilized;

inserting a first bone fastener assembly coupled to a first sleeve in the incision and
securing the first bone fastener assembly to a first one of the human vertebrae;

5 allowing the incision to determine an angle of the first sleeve relative to a bone fastener
of the first bone fastener assembly;

creating a tissue plane between the first sleeve and another one or more of the human
vertebrae to be stabilized;

10 inserting one or more other bone fastener assemblies, each coupled to a sleeve, in the
incision and securing each of the other bone fastener assemblies to another one of the human
vertebrae to be stabilized; and

guiding an elongated member down at least one channel in at least one of the sleeves,
through the incision, and through the tissue plane toward the bone fastener assemblies.

15 101. The method of claim 100, further comprising moving the incision toward the first one of
the human vertebrae to be stabilized before inserting the first bone fastener assembly.

20 102. The method of claim 100, further comprising using the first sleeve to move the incision
toward the first one of the human vertebrae to be stabilized before inserting the first bone
fastener assembly.

103. The method of claim 100, wherein the tissue plane has a substantially trapezoidal shape.

25 104. The method of claim 100, further comprising advancing the elongated member through
the tissue plane without visualization.

30 105. The method of claim 100, further comprising rotating the elongated member
subcutaneously without visualization and securing the elongated member to the bone fastener
assemblies.

106. A positioner for positioning an elongated member in a portion of a spinal implant system, comprising:

a hollow outer shaft comprising a first end and a second end, wherein the first end is coupled to a handle and the second end is coupled to a grasping member;

5 an inner shaft comprising a first end and a second end, wherein the first end is proximate the handle, and the second end is proximate the grasping member;

wherein the inner shaft is positioned in the outer shaft such that the inner shaft can move in the outer shaft;

wherein the positioner is configured to grasp an elongated member between the grasping member and the second end of the inner shaft during use; and

wherein the positioner is configured to allow a user of the positioner to grasp an elongated member and position the elongated member in the portion of the spinal implant system in a human body.

107. The positioner of claim 106, wherein the grasping member comprises a hook.

108. The positioner of claim 106, wherein the second end of the inner shaft is contoured.

109. The positioner of claim 106, wherein a portion of the inner shaft extends beyond the handle.

110. The positioner of claim 106, wherein the positioner is configured such that a relative position of the inner shaft and the outer shaft determines an angle at which the elongated member is held relative to the outer shaft by the grasping member and the second end of the inner shaft during use.

111. The positioner of claim 106, wherein the positioner is configured such that pressure applied to the first end of the inner shaft during use causes the second end of the inner shaft to approach the grasping member.

112. The positioner of claim 106, wherein the positioner is configured such that pressure applied manually to the first end of the inner shaft during use causes the second end of the inner shaft to approach the grasping member.

5 113. The positioner of claim 106, wherein the positioner is configured such that pressure applied mechanically to the first end of the inner shaft during use causes the second end of the inner shaft to approach the grasping member.

10 114. The positioner of claim 106, wherein the positioner is configured such that an amount of force applied to the first end of the inner shaft is adjusted during use to modify an angle between the outer shaft and an elongated member grasped between the grasping member and the second end of the inner shaft.

15 115. The positioner of claim 106, wherein the grasping member and the second end of the inner shaft are configured to grasp a straight elongated member such that the elongated member is substantially perpendicular to the outer shaft of the positioner.

20 116. The positioner of claim 106, wherein the grasping member and the second end of the inner shaft are configured to grasp a straight elongated member such that an angle between a portion of the elongated member and the outer shaft of the positioner is an acute angle.

25 117. The positioner of claim 106, wherein the positioner is configured such that relative movement of the first shaft and the second shaft during use allows an elongated member to be grasped between the grasping member and the second end of the inner shaft.

118. The positioner of claim 106, wherein the positioner is configured such that an orientation of the elongated member relative to the grasping member and the second end of the inner shaft is adjustable during use.

30 119. The positioner of claim 106, wherein the positioner is configured such that adjustment of a force used to grasp the elongated member between the grasping member and the second end of

the inner shaft during use allows adjustment of the orientation of the elongated member relative to the grasping member and the second end of the inner shaft.

120. A method of positioning an elongated member in a portion of a spinal stabilization system coupled to human vertebrae, comprising:

grasping the elongated member with a tool, wherein an angle between the elongated member and a shaft of the tool is determined by a user of the tool;

inserting the elongated member through an incision in skin near the human vertebrae, wherein an angle of the elongated member relative to the skin during insertion is determined by the user of the tool;

advancing the elongated member through a tissue plane toward the portion of the spinal stabilization system; and

positioning the elongated member in the portion of the spinal stabilization system, wherein an angle between the elongated member and the shaft of the tool is adjustable by the user during the positioning.

121. The method of claim 120, wherein at least a portion of the elongated member is substantially perpendicular to the skin during insertion.

122. The method of claim 120, wherein an angle between the elongated member and the shaft of the tool is substantially perpendicular during at least part of the positioning.